USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: MICROBIAL REDUCTIVE DEHALOGENATION OF CHLOROORGANIC COMPOUNDS UNDER ION-REDUCING CONDITIONS

Duration: April 1996 to March 1997

Fiscal Year 1996 Federal Funds: $10,000

Non-Federal Funds Allocated: $20,000

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Problem Statement

Chlorinated alkanes and alkenes -- such as carbon tetrachloride, chloroform, tetrachloroethylene (PCE), trichloroethylene (TCE) -- chlorinated benzenes as well as polychlorinated biphenyls (PCBs) are common soil/groundwater and sediment contaminants Pavlostathis and Mathavan, 1991; Prytula and Pavlostathis, 1995a; Prytula and Pavlostathis, 1995b). Because of the low water solubility and adsorption of these contaminants onto the soil/sediment matrix (especially organic matter), remediation technologies such as pump-and-treat have been used without much success because they deal only with the dissolved phase, leaving behind large quantifies of contaminants. Recent environmental regulations and public awareness of environmental and health concerns regarding these compounds have given the impetus for the development of technically feasible, cost effective remediation technologies. Biotransformation in subsurface environments has become recognized as a significant natural .detoxification process with great potential for in sire bioremediation of contaminated subsurface systems. Highly chlorinated compounds [e.g., PCE, hexachlorobenzene (HCB), PCBs) are recalcitrant under aerobic conditions, but are subject to reductive dehalogenation due to the high oxidation state of these compounds (Vogel *et al*. 1987). Reductive dehalogenation in subsurface environments is significant ecotoxicologically because it can form products with greater toxicity and mobility than the parent compounds, and may

play an important role in the natural attenuation (or intrinsic bioremediation) of contaminated sedimentary environments.

Because of the multiple uses of the chloroorganic compounds and the large volumes utilized in the past, soil and ground water contamination by these compounds is widespread throughout the United States. In the State of Georgia alone, several contaminated sites have been identified and include military installations, as well as active and inactive private industrial sites.

Results/Benefits Statement

This study will assess the capacity of iron-reducing bacteria to reductively dehalogenate polychlonnated organic compounds in subsurface environments leading to their detoxification either naturally (intrinsic biorerncdiation) or by enhancement (accelerated in situ bioremediation) Because of the relatively higher oxidation-reduction potential requirement of the iron-reducing bacteria as compared to that of sulfidogenic and methanogenic bacteria, the iron-reduction process may be more advantageous. The proposed research is in line with the U.S. Geological Survey and Georgia Water Resources Research Program' s mission on ground water quality protection and subsurface pollutant interactions.

Both State/Federal Agencies as well as the private sector will benefit from the results of the proposed project in two ways: a) information on the natural attenuation processes will provide a basis for appropriate decisions as to the fate and risk associated with the chlorinated contaminants; and b) development of remediation strategies to enhance the natural attenuation processes.